



---

## Jail Incarceration and Birth Outcomes

Janice F. Bell, Frederick J. Zimmerman, Mary Lawrence  
Cawthon, Colleen E. Huebner, Deborah H. Ward,  
and Carole A. Schroeder

---

**ABSTRACT** *This study examined the relationships between jail incarceration during pregnancy and infant birth weight, preterm birth, and fetal growth restriction. We used multivariate regression analyses to compare outcomes for 496 births to women who were in jail for part of pregnancy with 4,960 Medicaid-funded births as matched community controls. After adjusting for potential confounding variables, the relationship between jail incarceration and birth outcomes was modified by maternal age. Relative to controls, women incarcerated during pregnancy had progressively higher odds of low birth weight and preterm birth through age 39 years; conversely, jail detainees older than 39 years were less likely than controls to experience low birth weight or preterm birth. For women in jail at all ages, postrelease maternity case management was associated with decreased odds of low birth weight, whereas prenatal care was associated with decreased odds of preterm birth. Local jails are important sites for public health intervention. Efforts to ensure that all pregnant women released from jail have access to enhanced prenatal health services may improve perinatal outcomes for this group of particularly vulnerable women and infants.*

**KEYWORDS** *Birth weight, Jails, Pregnancy, Premature birth, Prenatal care utilization, Prisons, Prisoners, Small for gestational age.*

---

Women of childbearing age are the fastest growing segment of the US incarcerated population.<sup>1-4</sup> In 2002, more than 1 million women were under the custody or control of correctional agencies, including postconfinement supervision.<sup>1,3,5</sup> On any given day, more than 172,000 women were held in jails and prisons, primarily for nonviolent, often drug-related crimes such as drug possession, theft, fraud, and prostitution.<sup>1,3,6</sup> Most incarcerated women were of reproductive age, and at least 6% were pregnant at the time of arrest.<sup>1,3,4,7</sup>

Some researchers hypothesized that the stress of incarceration (e.g., separation from family, environmental restrictions, anxiety, and depression) compounds problems experienced during pregnancy.<sup>8-11</sup> Two ethnographic studies reported that imprisoned pregnant women experienced psychological distress, multiple complications, and poor birth outcomes.<sup>8,9</sup>

Other researchers reported no difference in infant birth weight for incarcerated women versus community controls.<sup>12-14</sup> For instance, Egley et al.<sup>12</sup> found higher

---

Ms. Bell is a doctoral candidate, Dr. Zimmerman is an Assistant Professor, and Dr. Huebner is an Associate Professor in the Department of Health Services, University of Washington; Dr. Cawthon is Project Manager for the First Steps Database, Washington State Department of Social and Health Services, Division of Research and Data Analysis; Drs. Ward and Schroeder are Associate Professors in the Department of Psychosocial and Community Health Nursing, University of Washington.

Correspondence: Janice F. Bell, MN, MPH, Child Health Institute, Box 354920, University of Washington, Seattle, WA 98195-4920. (E-mail: jfbell@u.washington.edu)

rates of smoking and drug use among women in prison compared to matched controls, yet no difference in birth weight. Mertens<sup>13</sup> reported that women in jail were no more likely to have a low birth weight infant (<2,500 grams) than women from their same urban neighborhoods. Using multivariate analyses, Martin et al.<sup>14</sup> found that birth weight was no different for infants born to women in prison compared with infants whose mothers were never incarcerated. However, imprisoned women gave birth to infants with higher birth weight than women who were in prison at a time other than pregnancy.

Other studies suggested aspects of the prison environment (including food, shelter, prenatal care, and restricted drug use) improve birth outcomes.<sup>15-17</sup> Martin et al.<sup>15</sup> found a positive association between the number of pregnancy days spent in prison and infant birth weight. Cordero et al.<sup>16</sup> reported fewer admissions to neonatal intensive care units with longer prison stays. Kyei-Aboagye et al.<sup>17</sup> found that imprisoned women with histories of drug use had higher birth weight infants than women in a community methadone program.

Taken together, studies of incarceration and birth outcomes have inconsistent findings. Many had small sample sizes and inadequate comparison groups. More important, most studies of incarceration and birth outcomes conducted to date described pregnant women in prisons<sup>8-10,12,14,15,17-19</sup>; much less is known about women in jails.<sup>13,16</sup> Unlike prisons, jails are locally administered and incarcerate individuals pending trial or serving sentences of 1 year or less.<sup>20</sup> With jail population turnover approximately 800% per year compared to 50% for prisons, jails house many more women each year than prisons.<sup>2,4,20</sup> Most jail detainees are released to their communities within a few weeks of arrest.

Women who have contact with jails are likely to experience ongoing psychosocial stress, which is shown to be associated with preterm birth and low infant birth weight.<sup>21,22</sup> Most women detained in jails live in poverty, and more than half reported past experiences of physical or sexual abuse.<sup>1,3</sup> Jail stays are reported to be extremely stressful, even for those with previous jail experience.<sup>23</sup> At the same time, jails provide minimal prenatal care and sometimes offer additional prenatal health services that would not be available or accessible to similarly marginalized women in the community.<sup>4,16</sup>

On balance, we hypothesized that, despite short-term access to prenatal care, women who had contact with jails during pregnancy would be more likely to have adverse birth outcomes than their counterparts in the community given their high likelihood of experiencing stress during pregnancy. Second, we hypothesized that relationships between jail incarceration and birth outcomes would be modified by maternal age. Demographic groups disproportionately represented in jail populations, notably African American and economically disadvantaged women, were reported to experience higher rates of adverse birth outcomes with advancing age when compared to more affluent white women.<sup>24,25</sup> Additional age-related factors associated with jail incarceration may affect birth outcomes. For example, older women in jails may have higher rates of recidivism, longer contact with the criminal justice system, and limited success in drug treatment.<sup>26-28</sup> Finally, we hypothesized that Medicaid-funded services, including prenatal care, maternity support services (i.e., home or office visits for health education and counseling), and maternity case management (i.e., care coordination and referral for women meeting specific risk criteria) would improve outcomes for women who have jail contact during pregnancy.

To test these hypotheses, we studied relationships between jail incarceration and three important indicators of maternal and infant health: birth weight, preterm

birth, and fetal growth restriction. We also examined frequency and timing of jail stays, as well as duration, as potential influences on birth outcomes.

## METHODS

### Design and Data Collection

The study used a retrospective cohort design to compare outcomes of births to women who had jail contact during pregnancy, with Medicaid-funded births serving as matched community controls. Identifying information was collected from public health and jail records for 743 women who had at least one prenatal care visit while in custody in a metropolitan King County (Seattle, Washington) jail and an estimated delivery date in 1994 through 1998. These women represented all pregnant women known to be in jail during this time. The identifying information was computer linked to vital records and Medicaid claims in the First Steps Database (FSDB) maintained by the Washington State Department of Social and Health Services, with 503 (68%) of the incarcerated women matched to 685 births in the FSDB.<sup>29</sup> Although jail records included documentation of all known aliases, the women's names recorded in the FSDB may have differed from those in the jail records. Up to one third of the pregnancies may have ended in miscarriage or abortion.<sup>30</sup>

### Study Sample

The study sample was restricted to births that met the following criteria: (1) maternal jail stay during pregnancy, determined by an arrest or release date occurring on or between dates of the mother's estimated last menstrual period<sup>31</sup> and her infant's birth; (2) live, singleton births occurring in Washington State from 1994 through 1998; and (3) maternal age greater than 17 years. We excluded twins and higher order multiple births because they are known to have lower birth weight than singletons<sup>32</sup>; younger women were excluded because they are typically held in juvenile detention facilities rather than jails. The final sample included 496 singleton births to 434 women.

Outcomes of births to women with jail contact were compared with those of births to Medicaid recipients who were not incarcerated in the study jail during pregnancy. The comparison group was selected at a ratio of 10:1 ( $n=4,960$ ) from the pool of 141,116 Medicaid-funded births that met inclusion criteria. Using stratified random sampling, controls' births were matched to the jail group by the proportion with maternal age 25 years and older, white race/ethnicity, parity greater than one, substance abuse, and smoking.

### Definitions and Data Sources

*Independent Variables* Exposure to jail during pregnancy was defined in four ways: (1) jail incarceration (yes/no); (2) duration of incarceration (i.e., the total number of pregnancy days spent in jail); (3) timing of incarceration (i.e., trimester of first incarceration); and (4) frequency of incarceration (i.e., the number of separate jail episodes during pregnancy categorized as one, two to three, more than three). Variables representing interactions of maternal age categories with jail were also examined as explanatory variables.

*Outcome Variables* Infant birth weight was coded as a continuous variable in grams as recorded on birth certificates and as low birth weight (<2,500 grams, yes/no),

one of the leading correlates of neonatal morbidity and mortality.<sup>33</sup> Infants with low birth weight may be born too early or may weigh less than expected for their gestational age.<sup>33</sup> Therefore, we examined preterm birth and fetal growth restriction as separate outcomes. Preterm birth was defined as birth prior to 37 weeks gestation (yes/no). Using sex-specific fetal growth guidelines developed by Alexander and colleagues,<sup>34</sup> we categorized fetal growth restriction as having a small-for-gestational-age infant with birth weight less than 10th percentile for gestational age (yes/no).

*Control Variables* Information recorded on the birth certificate was used to adjust the analyses for maternal age (categorized as 18–24, 25–29, 30–34, 35–39, or older than 39 years); self-identified racial/ethnic group (white, African American, other); sex of the infant (male, female); parity (1, 2–4, >4 prior births); and the following variables coded yes/no: married, completed high school, smoked, drank alcohol, prior preterm infant, nonurban maternal residence, and medical complications (cardiac disease, hypertension, or diabetes).

All adjusted models also included variables representing maternal use of illicit drugs during pregnancy, socioeconomic status, and use of health services. Maternal drug use, coded yes/no, was determined from provider reports on Medicaid claims or documentation in state-sponsored substance abuse assessment or treatment files. Socioeconomic status was coded categorically using a proxy derived from the type of Medicaid assistance the women were eligible to receive: cash grants, Medicaid only, or First Steps. These three categories correspond approximately to less than 60%, 60%–90%, and 91%–185% of the federal poverty level, respectively.

Three Medicaid-funded services were included as yes/no variables: (1) prenatal care prior to third trimester; (2) maternity support services, defined as home or office visits for assessment, counseling, and education by nurses, social workers, and nutritionists; and (3) maternity case management, defined as intensive care coordination throughout pregnancy with referral to needed medical, social, and educational services, targeted to women who meet specific high-risk criteria (e.g., substance abuse and maternal age < 20 years). Receipt of prenatal care was determined from documentation on birth certificates. Use of maternity support services and case management was determined using Medicaid claims.

## Analysis

All analyses were conducted using Stata statistical software Version 7 (Stata Corp., College Station, TX). Bivariate analyses were conducted to compare study variables for births to women with jail contact and controls. Multivariate linear regression was used to model birth weight as a continuous outcome in grams, and logistic regression was used to model binary outcomes (low birth weight, preterm birth, and small for gestational age) as functions of jail incarceration (yes/no) and age–jail interaction variables. To represent the age–jail interactions graphically and in a more flexible form, models were repeated using linear, quadratic, and cubic terms in age (Age, Age<sup>2</sup>, Age<sup>3</sup>) and their interactions with jail (Jail × Age, Jail × Age<sup>2</sup>, Jail × Age<sup>3</sup>). The estimated age-specific effects from these models were graphed to illustrate the adjusted mean trend in birth weight and the adjusted odds ratios for binary outcomes of births to women with jail contact relative to controls.

Jail exposure–response was assessed in birth weight models restricted to women who were incarcerated during pregnancy, with duration, frequency, and timing of incarceration included as explanatory variables. Results of these models were also examined to assess the contribution of prenatal care use, maternity support services,

and case management to birth outcomes of women with jail contact during pregnancy.

Rather than lose data by randomly selecting only one birth per woman, we employed the Huber-White estimator of variance in all models to obtain robust variance estimates that accounted for women having more than one birth during the study period.<sup>35</sup>

## RESULTS

### Profile of Women in Jail

Within the study sample, the most common reasons for incarceration were failures to appear in court, probation violations, property crimes, and drug offenses. The women spent from 1 to 254 pregnancy days in jail (median = 14 days). The number of separate jail episodes during pregnancy ranged from 1 to 10 (median = 1); most women (77%) had only one jail stay, 17% had two or three stays, and 6% had more than three stays. Half the women entered jail during their first trimester of pregnancy, 40% in their second, and 10% in their third. Of the 434 women, 379 were in jail for part of only one pregnancy, 49 for two pregnancies, 5 for three pregnancies, and 1 for four pregnancies.

Women in the jail and comparison groups were similar in many respects; however, after matching, the women who had been in jail still had lower income and education and higher parity and enrollment in maternity case management and were more likely to report African American race/ethnicity and urban residence (Table 1). These variables were controlled in the multivariate analyses.

### Jail and Infant Birth Weight

Unadjusted mean birth weight was significantly lower for infants whose mothers had been in jail (3,097.31 vs. 3,237.95 g,  $P < .01$ ). The coefficient for jail incarceration in the linear regression model of birth weight (Table 2, model 1), although not statistically significant, provided the estimated jail effect for a woman at age 0. Presented alone, this coefficient is not meaningful. The jail coefficient is modified by maternal age, meaning that in some maternal age groups, birth weight was no different for mothers in jail and controls, whereas in other age groups, jailed mothers had infants with either lower or higher birth weight.

Linear combinations of coefficients (Jail + Age  $\times$  Jail) from this model indicated that jailed mothers had significantly lower birth weight than controls at ages 30–34 (–161.41 g, 95% confidence interval [CI] –301.69 to –21.13) and 35–39 (–310.64, 95% CI –522.66 to –98.62). Contrary to expectations, however, this trend reversed above age 39 years, with a strong positive association between jail and birth weight for women in this age group (421.78 g, 95% CI 75.27 to 768.29). These estimates and confidence intervals were derived from the sum of the coefficient for the main effect of jail plus the relevant age-by-jail interaction term and therefore differ from those in Table 2.

A similar pattern of jail effect modification by maternal age for women above age 29 years was evident in the logistic regression model of low birth weight (Table 2, model 2). There were no significant differences in the odds of low birth weight between women in the jail and control groups at ages 18–29 years. Linear combinations of coefficients from this model (Jail + Age  $\times$  Jail) indicated, thereafter, that

**TABLE 1. Demographic and Perinatal characteristics: Washington State births (1994–1998)**

	Women in jail during pregnancy (n = 496 births), %	Comparison group (n = 4,960 births), %	P
Mother's age, years			
18–24	41.53	40.65	.19
25–29	25.81	29.64	
30–34	21.17	18.76	
35–39	9.07	9.44	
40 or older	2.42	1.51	
<i>Mother's race/ethnicity</i>			
White	52.62	53.31	
African American	33.87	18.79	<.01
Other	13.51	27.90	
Nonurban residence	4.62	8.28	.01
Married	12.70	34.01	<.01
Less than 12th grade education	35.28	50.56	<.01
<i>Socioeconomic status</i>			
Cash grant (<60% of FPL)	79.03	59.54	<.01
Medicaid only (60%–90% FPL)	2.42	16.73	
Expansion group (91%–185% FPL)	13.31	23.73	
Non-Medicaid	5.24	—	
<i>Prior living children</i>			
None	18.15	18.73	<.01
1–3	64.31	70.04	
4 or more	17.54	11.23	
Alcohol use	36.49	28.07	<.01
Substance abuse	56.45	55.38	.90
Cigarette smoking	54.23	54.44	.93
Female infant	52.02	48.97	.20
Prior preterm/SGA infant	3.02	3.08	.94
Pregnancy complications	8.67	6.92	.15
Prenatal care before third trimester	57.46	76.01	<.01
Case management	53.43	41.11	<.01
Support services	72.18	69.76	.27
Low birth weight	13.56	9.63	<.01
Preterm birth	15.32	11.33	<.01
Small for gestational age	17.74	15.24	.14

FPL, federal poverty level; SGA, small for gestational age.

women in jail were more likely to have a low birth weight infant at ages 30–34 years (odds ratio [OR] 1.68, 95% CI 1.01–2.81) and ages 35–39 years (OR 3.19, 95% CI 1.53–6.63). None of the women in the jail group older than 39 years had a low-birth-weight infant; therefore, an odds ratio could not be estimated for this age stratum.

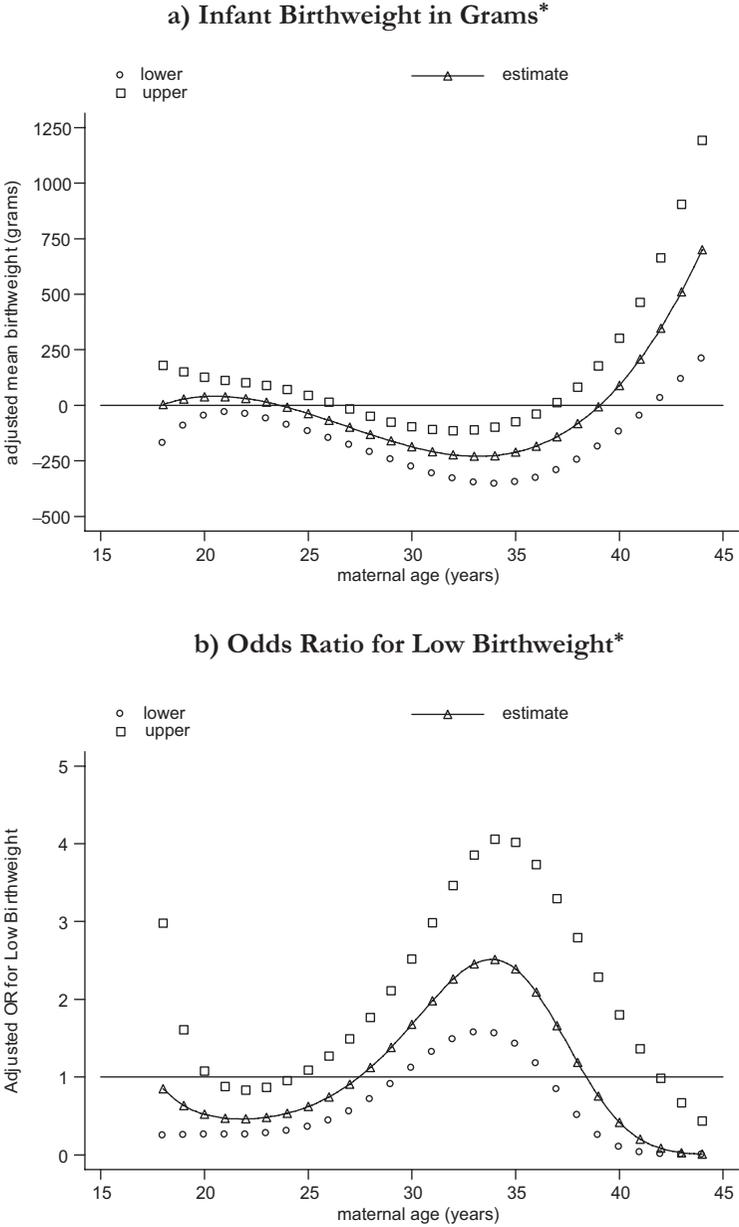
TABLE 2. Jail incarceration and infant birth weight (N = 5,456); Washington State births (1994–1998)\*

	Model 1: linear regression of birth weight (g)			Model 2: logistic regression of low birth weight (yes/no)			Model 3: logistic regression of preterm birth (yes/no)		
	Coefficient	95% CI	P	Odds ratio	95% CI	P	Odds ratio	95% CI	P
Jail (yes = 1, no = 0)	1.05	(-70.33 to 72.44)	.98	.57	(0.30 to 1.09)	.09	0.75	(0.43 to 1.31)	.32
<b>Jail × Age interactions</b>									
Jail × Age 18–24 (reference)	—	—	—	—	—	—	—	—	—
Jail × Age 25–29 years	-49.37	(-181.45 to 82.70)	.46	1.39	(0.54 to 3.59)	.49	0.90	(0.39 to 2.10)	.82
Jail × Age 30–34 years	-162.47	(-318.61 to -6.33)	.04	2.97	(1.30 to 6.76)	.01	2.69	(1.29 to 5.65)	<.01
Jail × Age 35–39 years	-311.70	(-534.64 to -88.76)	<.01	5.62	(2.12 to 14.89)	<.01	3.64	(1.49 to 8.90)	<.01
Jail × Age 40 years and older	420.73	(67.63 to 773.83)	.02	—	—	—	—	—	—
<b>Maternal race/ethnicity</b>									
White (reference)	—	—	—	—	—	—	—	—	—
African American	-201.06	(-245.60 to -156.51)	<.01	1.47	(1.16 to 1.86)	<.01	1.79	(1.43 to 2.23)	<.01
Other	-32.17	(-70.57 to 6.23)	.10	1.06	(0.83 to 1.37)	.62	1.52	(1.22 to 1.89)	<.01
Less than 12th-grade education	-75.79	(-108.82 to -42.77)	<.01	1.25	(1.02 to 1.52)	.03	1.22	(1.01 to 1.46)	.04
Substance abuse	-152.63	(-189.08 to -116.18)	<.01	2.15	(1.69 to 2.74)	<.01	1.59	(1.30 to 1.95)	<.01
Cigarette smoking	-163.72	(-197.22 to -130.22)	<.01	1.71	(1.39 to 2.11)	<.01	1.30	(1.08 to 1.57)	<.01
Alcohol use	-72.39	(-110.19 to -34.58)	<.01	1.46	(1.19 to 1.79)	<.01	1.25	(1.04 to 1.51)	.01
Prior preterm/SGA infant	-414.34	(-510.56 to -318.11)	<.01	4.55	(3.12 to 6.63)	<.01	2.91	(2.02 to 4.22)	<.01
Prenatal care before third trimester	136.04	(94.87 to 177.21)	<.01	0.56	(0.45 to 0.69)	<.01	0.55	(0.45 to 0.66)	<.01
Support services	52.09	(13.10 to 91.09)	<.01	0.73	(0.58 to 0.91)	<.01	0.75	(0.61 to 0.91)	<.01
Case management	40.56	(4.31 to 76.81)	.03	0.88	(0.71 to 1.10)	.26	0.76	(.62 to .94)	.01

CI, confidence interval; SGA, small for gestational age.

\*Controlling for the main effects of age (18–24 years, reference; 25–29 years; 30–34 years; 35–39 years; 40–44 years), marital status, parity, sex of the infant, socioeconomic status, medical complications, nonurban residence.

The mean trend in birth weight (Fig. 1a) and the adjusted odds of low birth weight (Fig. 1b) for infants born to women with jail contact relative to controls indicated that women aged 30–39 years had infants with lower birth weight and had higher odds of low birth weight. In contrast, women younger and older than this range had outcomes no different from, and at some ages better than, controls.



\*Figures 1a and 1b depict births to women in jail relative to comparison mothers

**FIGURE.** Effect modification of birthweight by maternal age for women in jail relative to comparison mothers, Washington State births 1994–1998: (a) infant birth weight in grams; (b) odds ratio for low birth weight.

### **Length of Gestation and Fetal Growth Restriction**

Compared with controls, women in jail had higher odds of preterm birth (unadjusted OR 1.42, 95% CI 1.08–1.86,  $P < .01$ ). The multivariate logistic regression model of preterm birth (yes/no) mirrored results of the birth weight models, exhibiting significant patterns of nonlinear effect modification of jail incarceration by maternal age (Table 2, model 3). Linear combinations of the estimated coefficients from this model (Jail + Age  $\times$  Jail) indicated women in jail were no more likely than controls to have a preterm birth through age 29 years; however, these odds were higher for women at ages 30–34 years (OR 2.04, 95% CI 1.24–3.35) and 35–39 years (OR 2.75, 95% CI 1.36–5.57). None of the jailed women in the oldest group (aged 40 years and older) had a preterm birth.

By contrast, there were no differences in the odds of having a small-for-gestational-age infant between jailed mothers and controls in any of the maternal age groups before or after adjusting for other covariates. (Results of this model are not shown in tables.)

### **Jail Exposure–Response**

Table 3 presents results of a linear regression model of birth weight and logistic regression models of low birth weight and preterm birth as functions of duration, timing, and frequency of incarceration. The adjusted mean birth weight increased by 2.23 g (Table 3, model 1), and the adjusted odds of low birth weight was 2% lower for each day spent in jail (Table 3, model 2). Duration of incarceration was not significantly associated with the odds of having a preterm birth (Table 3, model 3). Relative to women having only one jail stay during pregnancy, women having two or three separate stays had no difference in birth outcomes; women having more than three stays had infants with significantly lower birth weight (Table 3, model 1) and higher odds of preterm birth (Table 3, model 3). Timing of incarceration was not associated with any of the outcomes we examined. None of the exposure–response variables were associated with the odds of having a small-for-gestational-age infant. (These results are not shown in tables.)

### **Perinatal Health Service Use**

For the study population, prenatal care, maternity support services, and case management were protective against low birth weight and preterm birth in models adjusted for jail incarceration (Table 2). However, in models restricted to women who had been in jail (Table 3), only maternity case management improved birth weight, and only prenatal care use was associated with lower odds of preterm birth.

### **COMMENT**

To our knowledge, this was the first study to use multivariate methods to examine infant outcomes in a large sample of pregnant women in an urban jail setting. Four important findings warrant discussion: jail effect modification by maternal age, jail exposure–response, the role of substance abuse, and the effectiveness of community-based prenatal health services.

### **Jail Effect Modification by Maternal Age**

We hypothesized that stress, arising either from jail incarceration or its socioeconomic determinants, would lead to more adverse birth outcomes for incarcerated mothers. Our study results were not consistent with this hypothesis at all maternal

**TABLE 3. Jail exposure-response<sup>a</sup>: births to women in jail during pregnancy (N = 496)**

	Model 1: linear regression of birth weight (g)			Model 2: logistic regression of low birth weight (yes/no)			Model 3: logistic regression of preterm birth (yes/no)		
	Coefficient	95% CI	P	Odds ratio	95% CI	P	Odds ratio	95% CI	P
Pregnancy days in jail	2.23	(0.68–3.78)	<.01	0.98	(0.97–0.99)	<.01	0.99	(0.98–1.00)	.18
Number of jail episodes									
1 (reference)	—	—	—	—	—	—	—	—	—
2–3	-16.24	(-134.03 to 101.55)	.79	1.03	(0.52–2.02)	.93	0.83	(0.41–1.67)	.59
4 or more	-223.80	(-438.40 to -9.20)	.04	3.61	(0.95–13.66)	.06	3.92	(1.30–11.81)	.01
Trimester of first jail stay									
First trimester (reference)	—	—	—	—	—	—	—	—	—
Second trimester	-23.57	(-141.10 to 93.95)	.69	1.03	(0.51–2.09)	.93	1.10	(0.57–2.14)	.76
Third trimester	-30.71	(-245.06 to 183.65)	.78	2.01	(0.61–6.63)	.25	0.95	(0.31–2.91)	.93
Maternal age, years									
18–24 (reference)	—	—	—	—	—	—	—	—	—
25–29	-97.21	(-237.58 to 43.16)	.17	1.69	(0.62–4.63)	.30	1.46	(0.60–3.56)	.40
30–34	-280.86	(-463.25 to -98.46)	<.01	6.88	(2.50–18.90)	<.01	6.31	(2.73–14.60)	<.01
35–39	-496.26	(-732.25 to -260.28)	<.01	12.10	(3.61–40.54)	<.01	8.24	(2.95–23.02)	<.01
40 and older	83.86	(-229.96 to 397.69)	.60	—	—	—	—	—	—
Less than 12th-grade education	-125.84	(251.53 to -0.15)	.05	2.64	(1.21–5.76)	.01	1.68	(0.88–3.22)	.11
Substance abuse	-224.85	(-346.88 to -102.82)	<.01	2.23	(1.03–4.85)	.04	0.98	(0.50–1.91)	.95
Prenatal care before third trimester	30.82	(-79.85 to 141.48)	.58	0.82	(0.44–1.51)	.52	0.43	(0.24–0.78)	<.01
Case management	148.75	(30.03–267.48)	.01	0.39	(0.18–0.84)	.02	0.89	(0.42–1.89)	.77

CI, confidence interval; SGA, small for gestational age.

<sup>a</sup>Controlling for self-reported race/ethnicity, marital status, parity, sex of the infant, alcohol use, smoking, socioeconomic status, medical complications, nonurban residence, prior preterm/SGA infant, and support services.

ages. No differences in birth weight or rates of preterm birth were apparent at maternal ages 18–29 years. As expected, women at ages 30–39 years with jail contact had infants with lower birth weight and higher rates of preterm births than matched controls at the same ages. At ages older than 39 years, women who had been in jail had infants with higher birth weight and lower rates of preterm birth than controls. This age group included only 12 births to women who had been in jail, none of which were low birth weight or preterm, whereas 22% of births to community controls were low birth weight, and 27% were preterm.

The finding that outcomes of younger women in jail were no different from controls is extremely important. Younger women may be more resilient to stress, in better general health, less severely chemically dependent, or more successful in drug treatment programs. These factors could diminish differences in outcomes when compared with matched controls. Intervention to facilitate access to essential services, especially drug treatment, for younger women who have contact with jails may help forestall detrimental effects on birth outcomes for subsequent children.

The finding that the oldest women in jail had better outcomes than controls was unexpected and has at least four possible explanations. First, although this finding was statistically significant at the .05 level, we cannot rule out that the results were caused by chance given the small number of births to women in jail in this age group. Second, this result could be attributed to selection bias insofar as unhealthy women who have contact with jails exit their childbearing years earlier than women in better health. Exposure to stress over the life course may undermine a woman's reproductive potential at advanced maternal ages.<sup>24,25</sup> Third, exposure to jail, even short term, may be protective for older women perhaps because of regular meals, ongoing prenatal care, or restricted smoking and drug use. Finally, there may be differences in ways older women are sentenced to jail. For example, those with chronic illnesses may be granted pretrial release or receive more lenient sentences.

Previous studies of pregnant women in prison have not evaluated potential effect modification by age. Further research is needed to examine relationships between maternal stress and birth outcomes for incarcerated women and to determine whether effect modification by age persists in other samples. Results of the present study indicated that, if stress associated with jail is detrimental to birth outcomes, its effects are not the same at all maternal ages. Similarly, if aspects of jail are protective for pregnant women, advantages are not uniform in all age groups. Additional research is needed to determine whether individual or systemwide factors buffer or enhance the effects of jail.

Our results suggested that the observed associations between jail and birth weight were primarily caused by higher rates of preterm births rather than higher rates of fetal growth restriction. Results of preterm birth and low birth weight models were similar (Table 2), and rates of small for gestational age were no different among women in the jail and control groups.

In Table 2, well-established risk factors—including having a prior preterm birth, substance abuse, cigarette smoking, alcohol use, and African American race/ethnicity—were most strongly associated with low birth weight. These findings are consistent with prior studies. However, in models restricted to women who had been in jail (Table 3), well-known risk factors for low birth weight, including African American race/ethnicity, high or low parity, smoking, and medical complications were not statistically significant. A high proportion of women in this group were noted to have these risk factors, perhaps with insufficient variation to estimate their effects.

### **Jail Exposure—Response**

We found no prior studies that examined frequency and timing of jail contact as potential predictors of infant outcomes. Our results indicated that frequent contact with jail during pregnancy, specifically having more than three episodes of incarceration, was associated with lower birth weight and higher rates of preterm birth. This finding is plausible; multiple jail episodes during pregnancy could be associated with preexisting factors that lead to poor outcomes, including more severe chemical dependency, greater poverty, or higher levels of stress. Consistent with previous studies, we found a positive association between duration of incarceration and birth weight.<sup>15,16</sup> This relationship was not statistically significant for rates of preterm birth. Moreover, the magnitude of the improvement in birth weight is likely to be extremely small given the short lengths of most jail stays.

### **The Role of Substance Abuse**

The women in the jail group used alcohol, drugs, or both at much higher rates than estimates for women who had Medicaid-funded births in Washington State.<sup>36</sup> We did not have information about the specific type, frequency, or intensity of drug use. The type of drug(s) used or the severity of use could explain some of the study findings. However, it is unlikely that our findings were solely caused by differences in drug use by age between the women in jail versus community controls. We tested effect modification of substance abuse on outcomes by maternal age with no change in reported findings.

### **Prenatal Health Service Use and Perinatal Outcomes**

Prenatal care, maternity support services, and case management had positive and independent effects on infant birth weight for the overall study population (Table 2). In a study of Washington State's enhanced prenatal services for Medicaid-enrolled pregnant women, Baldwin et al.<sup>37</sup> found a statewide decline in low birth weight associated in part with improvements in low birth weight for medically high-risk women. These findings were attributed to the joint effects of enhanced prenatal care services. The current study demonstrated independent effects of each service, perhaps because of the focus on a higher risk population.

For women in jail, however, only prenatal care was associated with improved rates of preterm birth and maternity case management with higher birth weight (Table 3). In a recent study of substance-using women in a large urban jail, participants reported postrelease needs for chemical dependency treatment, mental health counseling, housing, education, jobs, parenting assistance, and health care.<sup>38</sup> These are basic needs more likely to be addressed by maternity case management than by support services. Presumably, case management is beneficial for this population because it is more continuous and offers linkage to needed medical, social, and educational services.

In Washington State, emphasis is placed on facilitating access to maternity case management for substance-abusing women. Results of this study suggested this emphasis is well placed. Expanding maternity case management services to include all incarcerated pregnant women could lead to even greater improvements in birth outcomes.

### **Study Limitations**

Limitations of this study relate primarily to use of vital statistics data. Potential errors in misclassification of birth weight or gestational age were offset by focusing

on clinically relevant binary measurements of low birth weight and preterm birth. Complications, preexisting conditions, and maternal health behaviors such as cigarette smoking are known to be underreported on birth certificates.<sup>39–41</sup> For this study, measures of alcohol or drug use were enhanced by including information submitted by providers on Medicaid claims. In addition, health service use is subject to selection bias.<sup>42</sup> It is unknown whether these biases constitute random measurement error or are correlated with incarceration.

Our study focused on women in one county jail and used incarceration data not routinely available for pregnant women. Some of the women in the comparison group may have been incarcerated in other counties during pregnancy, in which case our estimates were conservative. Women in either group may have been sentenced to prison. Finally, the study was restricted to an urban jail and available prenatal health services in Washington State, possibly limiting generalizability of results. The proportion of women reporting white race/ethnicity, for example, was greater in our study sample than in reports describing demographic characteristics of women held in jails nationwide.

### Implications

Correctional facilities are important sites for public health intervention to improve birth outcomes for high-risk women. In this study, many women in jail had higher rates of low birth weight and preterm birth compared to controls. Enhanced prenatal services beginning in jail and outreach to ensure that prenatal care and other services continue after release can improve outcomes for this population. A significant opportunity exists for public health and criminal justice professionals to develop effective, comprehensive programs for incarcerated pregnant women.<sup>43</sup> Ideally, such programs would include enhanced prenatal care services in the community and greater transitional resources given the short-term nature of jail incarceration.

### ACKNOWLEDGEMENT

Kathy Carson, Cecilia Warnke, and Holly Wollaston of Public Health–Seattle and King County and Bob DeNeui and Martha Robins of the King County Department of Adult and Juvenile Detention provided invaluable support for this research. We also thank Callie Sundarum and Peter Woodcox of Washington State Department of Social and Health Services, Division of Research and Data Analysis, for assistance with data linkage. The study was reviewed and approved by the Washington State Institutional Review Board. Ms. Bell gratefully acknowledges funding received from the Agency for Healthcare Research and Quality (T32-HS013853–01) for some of her work on this study.

### REFERENCES

1. Greenfeld LA, Snell TL. *Women Offenders*. Washington, DC: US Dept. of Justice; 1999. NCJ-175688.
2. Beck AJ, Karberg JC, Harrison PM. *Prison and Jail Inmates at Midyear 2001*. Washington, DC: Bureau of Justice Statistics; 2002. NCJ-191702.
3. Snell TL. *Women in Prison*. Washington, DC: US Dept. of Justice; 1994. NCJ-145321.
4. Safyer SM, Richmond L. Pregnancy behind bars. *Semin Perinatol*. 1995;19:314–322.
5. Glaze LE. *Probation and Parole in the United States, 2001*. Washington, DC: US Dept. of Justice; 2002. NCJ-195669.

6. Harrison PM, Karberg JC. *Prison and Jail Inmates at Midyear 2002*. Washington, DC: Bureau of Justice Statistics; 2003. NJC 198877.
7. Baldwin KM, Jones J. Health issues specific to incarcerated women: information for state maternal and child health programs. Women's and Children's Health Policy Center, Johns Hopkins University. Accessed May 22, 2004. Available at: <http://www.med.jhu.edu/wchpc>.
8. Shelton B, Armstrong F, Cochran SE. Childbearing while incarcerated. *MCN Am J Matern Child Nurs*. 1983;8:23–24.
9. Shelton BJ, Gill DG. Childbearing in prison: a behavioral analysis. *J Obstet Gynecol Neonatal Nurs*. 1989;18:301–308.
10. Fogel CI. Pregnant inmates: risk factors and pregnancy outcomes. *J Obstet Gynecol Neonatal Nurs*. 1993;22:33–39.
11. Hufft AG. Psychosocial adaptation to pregnancy in prison. *J Psychosoc Nurs Ment Health Serv*. 1992;30:19–22.
12. Egley CC, Miller DE, Granados JL, Ingram FC. Outcome of pregnancy during imprisonment. *J Reprod Med*. 1992;37:131–134.
13. Mertens DJ. Pregnancy outcomes of inmates in a large county jail setting. *Public Health Nurs*. 2001;18:45–53.
14. Martin SL, Kim H, Kupper LL, Meyer RE, Hays M. Is incarceration during pregnancy associated with infant birthweight? *Am J Public Health*. 1997;87:1526–1531.
15. Martin SL, Rieger RH, Kupper LL, Meyer RE, Qaqish BF. The effect of incarceration during pregnancy on birth outcomes. *Public Health Rep*. 1997;112:340–346.
16. Cordero L, Hines S, Shibley KA, Landon MB. Duration of incarceration and perinatal outcome. *Obstet Gynecol*. 1991;78:641–645.
17. Kyei-Aboagye K, Vragovic O, Chong D. Birth outcome in incarcerated, high-risk pregnant women. *J Reprod Med*. 2000;45:190–194.
18. Cordero L, Hines S, Shibley KA, Landon MB. Perinatal outcome for women in prison. *J Perinatol*. 1992;12:205–209.
19. Elton PJ. Mothers and babies in prison. *Lancet*. 1987;2:501–502.
20. Glaser JB, Greifinger RB. Correctional health care: a public health opportunity. *Ann Intern Med*. 1993;118:139–145.
21. Paarlberg KM, Vingerhoets AJ, Passchier J, Dekker GA, Van Geijn HP. Psychosocial factors and pregnancy outcome: a review with emphasis on methodological issues. *J Psychosom Res*. 1995;39:563–595.
22. Peacock JL, Bland JM, Anderson HR. Preterm delivery: effects of socioeconomic factors, psychological stress, smoking, alcohol, and caffeine. *BMJ*. 1995;311:531–535.
23. Marcus P, Alcabes P. Characteristics of suicides by inmates in an urban jail. *Hosp Community Psychiatry*. 1993;44:256–261.
24. Geronimus AT. Understanding and eliminating racial inequalities in women's health in the United States: the role of the weathering conceptual framework. *J Am Med Womens Assoc*. 2001;56:133–136, 149–150.
25. Geronimus AT. The weathering hypothesis and the health of African-American women and infants: evidence and speculations. *Ethn Dis*. 1992;2:207–221.
26. Henderson DJ. Drug abuse and incarcerated women. A research review. *J Subst Abuse Treat*. 1998;15:579–587.
27. McCarthy JE, Siney C, Shaw NJ, Ruben SM. Outcome predictors in pregnant opiate and polydrug users. *Eur J Pediatr*. 1999;158:748–749.
28. Sprauve ME, Lindsay MK, Herbert S, Graves W. Adverse perinatal outcome in parturients who use crack cocaine. *Obstet Gynecol*. 1997;89:674–678.
29. Cawthon ML, Salazar E. *The First Steps Program: 1989–1997*. Olympia, WA: Washington State Dept. of Social and Health Services; 1999. RDA Publication 7.99.
30. *Pregnancy and Induced Abortion Statistics*. Olympia, WA: Washington State Dept. of Health; 2000.
31. Alexander GR, Tompkins ME, Petersen DJ, Hulsey TC, Mor J. Discordance between LMP-based and clinically estimated gestational age: implications for research, programs, and policy. *Public Health Rep*. 1995;110:395–402.

32. Martin JA, Park MM. Trends in twin and triplet births: 1980–97. *Natl Vital Stat Rep.* 1999;47:1–16.
33. Paneth NS. The problem of low birthweight. *Future Children.* 1995;5:19–34.
34. Alexander GR, Himes JH, Kaufman RB, Mor J, Kogan M. A United States national reference for fetal growth. *Obstet Gynecol.* 1996;87:163–168.
35. Deaton A. *The Analysis of Household Surveys.* Baltimore, MD: Johns Hopkins University Press; 1997.
36. Schrager LS, Joyce J, Cawthon ML. *Substance Abuse, Treatment, and Birth Outcomes for Pregnant and Postpartum Women in Washington State.* Olympia, WA: Washington State Dept. of Social and Health Services; 1995. RDA Publication 7.99.
37. Baldwin LM, Larson EH, Connell FA, et al. The effect of expanding Medicaid prenatal services on birth outcomes. *Am J Public Health.* 1998;88:1623–1629.
38. Alemagno SA. Women in jail: is substance abuse treatment enough? *Am J Public Health.* 2001;91:798–800.
39. DiGiuseppe DL, Aron DC, Ranbom L, Harper DL, Rosenthal GE. Reliability of birth certificate data: a multi-hospital comparison to medical records information. *Matern Child Health J.* 2002;6:169–179.
40. Dobie SA, Baldwin LM, Rosenblatt RA, Fordyce MA, Andrilla CH, Hart LG. How well do birth certificates describe the pregnancies they report? The Washington State experience with low-risk pregnancies. *Matern Child Health J.* 1998;2:145–154.
41. *Washington State Birth Certificate System: an Evaluation.* Olympia, WA: Washington State Dept. of Health; May 1998.
42. Bell JF, Zimmerman FJ. Selection bias in prenatal care use by Medicaid recipients. *Matern Child Health J.* 2003;7:239–252.
43. *A Comprehensive Program for Alcohol and Drug Abusing Mothers and Their Young Children: Response to RCW 13.34.803.* Olympia, WA: Washington Dept. of Social and Health Services, Research and Data Analysis Division; 1999. RDA Publication 7.98.